

Tilburg University

## Variation in raven's progressive matrices scores across time and place

Brouwers, S.A.; van de Vijver, F.J.R.; van Hemert, D.A.

*Published in:*  
Learning and Individual Differences

*DOI:*  
[10.1016/j.lindif.2008.10.006](https://doi.org/10.1016/j.lindif.2008.10.006)

*Publication date:*  
2009

*Document Version*  
Publisher's PDF, also known as Version of record

[Link to publication in Tilburg University Research Portal](#)

*Citation for published version (APA):*  
Brouwers, S. A., van de Vijver, F. J. R., & van Hemert, D. A. (2009). Variation in raven's progressive matrices scores across time and place. *Learning and Individual Differences*, 19(3), 330-338.  
<https://doi.org/10.1016/j.lindif.2008.10.006>

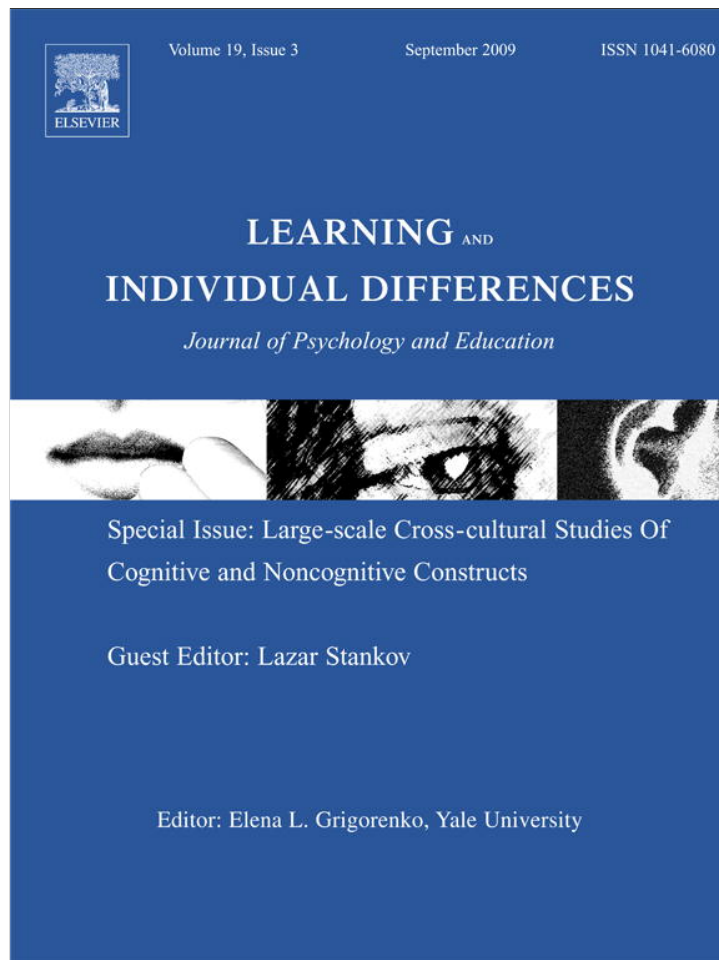
### General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

### Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.



This article appeared in a journal published by Elsevier. The attached copy is furnished to the author for internal non-commercial research and education use, including for instruction at the authors institution and sharing with colleagues.

Other uses, including reproduction and distribution, or selling or licensing copies, or posting to personal, institutional or third party websites are prohibited.

In most cases authors are permitted to post their version of the article (e.g. in Word or Tex form) to their personal website or institutional repository. Authors requiring further information regarding Elsevier's archiving and manuscript policies are encouraged to visit:

<http://www.elsevier.com/copyright>



Contents lists available at ScienceDirect

## Learning and Individual Differences

journal homepage: [www.elsevier.com/locate/lindif](http://www.elsevier.com/locate/lindif)

## Variation in Raven's Progressive Matrices scores across time and place

Symen A. Brouwers<sup>a,\*</sup>, Fons J.R. Van de Vijver<sup>a,b</sup>, Dianne A. Van Hemert<sup>c</sup><sup>a</sup> Tilburg University, The Netherlands<sup>b</sup> North-West University, South Africa<sup>c</sup> University of Amsterdam, The Netherlands

## ARTICLE INFO

## Article history:

Received 21 November 2007

Received in revised form 15 September 2008

Accepted 5 October 2008

## Keywords:

Cross-cultural comparisons

Flynn effect

Intelligence

Raven's Progressive Matrices

## ABSTRACT

The paper describes a cross-cultural and historical meta-analysis of Raven's Progressive Matrices. Data were analyzed of 798 samples from 45 countries ( $N=244,316$ ), which were published between 1944 and 2003. Country-level indicators of educational permeation (which involves a broad set of interrelated educational input and output factors that are strongly related to economic development), the samples' educational age, and publication year were all independently related to performance on Raven's matrices. Our data suggest that the Flynn effect can be found in high as well as low GNP countries, although its size is moderated by education-related sample and country characteristics and seems to be smaller in developed than in emerging countries.

© 2008 Elsevier Inc. All rights reserved.

Raven's Progressive Matrices are a series of multiple-choice items of abstract reasoning. Each item depicts an abstract pattern in a two by two or three by three matrix; all cells contain a figure except for the cell in the right lower corner. Participants are asked to identify the missing segment that would best complement the pattern constituted by the other cells among a set of alternatives that are positioned beneath the matrix. John C. Raven published the first version of the test in 1938 and a revised version in 1956; the three versions of the test (Advanced, Colored, and Standard Progressive Matrices) have since been among the most widely-used intelligence tests. Its intuitively appealing question format and the use of figure stimuli have made the test attractive for cross-cultural comparisons. A meta-analysis of cross-cultural intelligence test scores showed that the Raven is the second most used test after the Wechsler Intelligence Scales for Children (Van de Vijver, 1997). This widespread usage makes the test an interesting instrument for a cross-cultural meta-analysis. Moreover, the period in which the Raven has been used in various countries is long enough for enabling a study of the temporal patterning of scores. In the present paper, we report a meta-analysis of Raven performance of children and adults from 45 countries across a time span of 60 years.

Cross-cultural comparisons with the Raven tests are often conducted from the premise that the instrument measures cross-cultural differences in intelligence that are not confounded by other cultural or national differences, such as education and affluence (Raven, 2000; Rushton, Skuy, & Bons, 2004). 'Culture-free' (Cattell, 1940), 'culture-fair' (Cattell & Cattell, 1963), and 'culture-reduced' (Jensen, 1980) are all terms that have been proposed to describe the Raven or similar tests that do not seem to require much cultural

knowledge for answering the items correctly. Particularly the first two labels are not undisputed. As early as 1966, Frijda and Jahoda argued that it is impossible to measure intelligence without the confounding influence of cultural factors, as both the definition of the concept and its expression are cultural. Nevertheless, the Raven tests are still considered to be measures of intelligence that show less influence of confounding cultural factors on the cross-national differences than any other intelligence test.

Both synchronic and diachronic evidence for variation of Raven test scores has been presented (Flynn, 1987, 2007; Lynn, 1982). The rise of intelligence test scores over time is commonly known as the Flynn effect and has been ascribed to various factors such as improved nutrition (Colom, Lluís-Font, & Andres-Pueyo, 2005), increased environmental complexity (Schooler, 1998), and socialization practices at home and at school (Williams, 1998). However, the bulk of research into the Flynn effect is based on individuals from high affluence countries. More recently, evidence begins to accumulate that the Flynn effect is not confined to high affluence countries or countries that invest strongly in education. Daley, Whaley, Sigman, Espinosa, and Neumann (2003) were the first to show a Flynn effect outside the twenty largest industrialized countries. In rural Kenya they found that performance on the Raven's Progressive Matrices had undergone a strong increase across a fourteen-year interval. The latter study points to the potential cross-cultural generalizability of the Flynn effect. A cross-cultural meta-analysis of Raven test scores across a long period might help to examine this generalizability and to address the role of potentially moderating variables such as educational differences between countries.

Much has been written about the relation between country characteristics and individual test scores (Ceci, 1991; Flynn, 2007; Luria, 1976; Lynn & Vanhanen, 2006; Rindermann, 2007). Cross-

\* Corresponding author.

E-mail address: [symen.brouwers@ugent.be](mailto:symen.brouwers@ugent.be) (S.A. Brouwers).

cultural research has led to the need to make a distinction between intelligence and intelligence test scores (Vernon, 1979). Cross-cultural Piagetian research uses a similar distinction. Here, competence is taken to be rather distinct from performance (Dasen, 1977). The conceptual differentiation of competence and performance is meant to accommodate the influence of various, potentially biasing factors that might cause a disparity between 'real' and 'observed' intelligence. Examples of such factors are previous test exposure, cultural appropriateness of an instrument and its administration procedures, in addition to confounding sample characteristics. Van de Vijver and Leung (1997) coined the term 'method bias' to refer to the overall impact caused by these confounding factors and there is empirical evidence to suggest that they may contribute to actual Raven performance. For example, Ombrédane, Robaye, and Plumail (1956) showed that the predictive validity of Raven test scores became stronger by repeated administration in a group of illiterate, Congolese mine workers. Moreover, retest effects due to method factors are not restricted to non-Western participants alone and are known to prevail among Westerners (e.g., Blieszner, Willis, & Baltes, 1981; Wing, 1980). Te Nijenhuis, Van Vianen, and Van der Flier (2007) were able to show in a meta-analysis that gains on intelligence test scores after retesting or intervention tend not to be related to general intelligence ('g'). These findings are in line with our notion of method bias.

Educational indicators are relevant country characteristics in the examination of cross-cultural differences in intelligence test scores. From an ontogenetic perspective, educational indicators relate to the frequency with which people have opportunities for cognitive stimulation. The Raven's Progressive Matrices are measures of reasoning and in order to reason people need opportunities for learning how to transform given information into conclusions (Galotti, 1989). Vygotsky (1978) directly related education to the potential gap between competence and performance. He reasoned that performance only reflects one's actual level of development and thus only the development that is already completed. Working in rural Tanzania, Sternberg and colleagues examined the utility of dynamic testing of school-attending children (Sternberg et al., 2002). They familiarized children with the skills and strategies that are thought to contribute to success on tests of cognitive ability. A significant gain in test scores after training was observed, which was not present in the untrained group (which received the same tests the same number of times). The relationship between educational indicators and test performance at country level cannot be solely interpreted as a simple consequence of increased intellectual functioning through schooling. The influence of test bias should also be taken into account; the Raven might contain elements that benefit people from one country more than people from another country.

Educational indicators such as expenditure per capita, educational level of teachers, and enrolment rates have been shown to predict country-level scores on cognitive instruments (Van de Vijver, 1997). Educational quality indicators are known to belong to a cluster of variables that denote economic development (Georgas, Van de Vijver, & Berry, 2004). Other variables in this cluster are enrolment into primary, secondary, and tertiary education, Gross National Product, percentage of population working in service industry, use of mass media, prevalence of telephones, and population growth (the last one with a negative relation). At country level these educational indicators would together denote "educational permeation", which refers to the degree in which formal education has permeated society and might on average be encountered by the population of that society. Countries with a high educational permeation thus have many schools and these schools have high quality teaching materials and qualified teachers, a highly educated population, and a high demand for jobs that require higher education.

We present here a meta-analysis of studies that reported data on Raven's Progressive Matrices, comprising samples of children and adults from 45 countries covering a period of 60 years. Publication

**Table 1**  
Frequencies of studies per country and year of publication.

Characteristics	Number of studies
<b>Countries</b>	
Congo, France, Mexico, Norway, Qatar, South Korea, Sweden, Syria, Venezuela	1
Austria, Belgium, Brazil, Denmark, Egypt, Germany (East), Iceland Ireland, Japan, Kenya, Nigeria, Singapore, Spain, Czechoslovakia, Ghana, Hong-Kong, Israel, Italy, Netherlands, Romania, Taiwan, Tanzania, Yugoslavia	2 to 10
Argentina, Australia, Canada, China, Germany (West), India, Iran, New Zealand, Poland, Slovakia, South Africa, United Kingdom, United States of America	11 to 19
	more than 20
<b>Year of publication</b>	
1944–1953	61
1954–1963	26
1964–1973	25
1974–1983	126
1984–1993	408
1994–2003	152

year, educational permeation (measured by a broad set of interrelated educational input and output factors at country level), and educational age are the three most important variables that are examined in the analysis. Based on the literature, we expect Raven performance to increase with educational age (operationalized as the average number of years of schooling of the study sample) and indicators of educational quality (at country level), and we expect an increase of performance scores over time (Flynn effect).

## 1. Method

### 1.1. Sample

Studies that report data on Raven's Progressive Matrices were located through PsycInfo (1887 to 2003), the Social Sciences Citation Index, the Researcher's Bibliography for Raven's Progressive Matrices and Mill Hill Vocabulary Scales (Court, 1995), and the catalogue of Dutch libraries. In addition, a request for data was sent to 200 authors around the world, plus mailing lists in relevant research areas. Other reports were found through snowballing on the basis of reference lists in studies already identified. Data that concerned Standard Progressive Matrices (SPM), Colored Progressive Matrices (CPM), and Advanced Progressive Matrices II (APM II) were included. Sample sizes and raw mean or median scores had to be available for all cases. Clinical populations, mentally retarded groups, and other samples selected solely on the basis of intellectual capacity were not included in the present study.

The total sample consists of 193 studies; scoring all individual samples separately for age and gender resulted in a total number of 798 subsamples; the total sample size was 244,316. The data set involves 45 countries and covers the period from 1944 to 2003. Table 1 presents the distribution of the 798 subsamples across 45 countries and 60 years of publication. There is a clear bias in the distributions across country and year of publication. The United Kingdom, the United States of America and Poland have seen many studies, whereas countries as varied as Venezuela, Syria, Sweden, South Korea, Qatar, Norway and Mexico have all seen only one study (and most countries have never seen any study). The distribution of studies over time is skewed towards the present, with particularly high numbers for the period between 1984 and 1993. The same is true for the number of cultures per year. Data from many cultures were reported in the mid-1990s studies, but data from very few different cultures were reported until 1981. Of the different versions (APM, CPM, and SPM), the SPM is by far the most used (62.3% of 798 samples), followed by the CPM with 27.3% and the APM with only 10.4%.

**Table 2**  
Mean scores and mean IQ scores by country.

Country	Mean scores on 100 scale			Mean IQ scores		
	Raw	Corrected		Raw	Corrected	
		Year	Sample		Year	Sample
Argentina	57.36	56.65	58.88	95.85	95.43	97.26
Australia	70.84	70.36	70.29	111.65	111.47	111.37
Austria	64.21	63.57	63.35	103.88	103.53	102.79
Belgium	67.62	66.92	60.21	107.88	107.45	98.91
Brazil	37.37	36.67	34.97	72.42	72.06	67.69
Canada	59.05	59.14	59.78	97.83	98.35	98.37
China	63.56	63.13	63.22	103.12	103.02	102.63
Congo	39.17	38.28	39.99	74.53	73.94	73.90
Czechoslovakia	63.46	63.52	65.25	103.00	103.47	105.14
Denmark	45.86	45.16	48.72	82.37	81.99	84.70
Egypt	70.83	70.50	69.22	111.64	111.64	110.05
France	67.17	66.28	68.14	107.35	106.70	108.71
Germany (East)	50.28	50.04	52.34	87.55	87.70	89.17
Germany (West)	70.03	69.90	69.56	110.70	110.94	110.47
Ghana	49.36	47.73	49.00	86.47	85.00	85.04
Hong Kong	63.10	62.54	64.69	102.58	102.32	104.45
Iceland	66.40	64.68	67.61	106.45	104.83	108.06
India	51.10	50.81	51.74	88.51	88.60	88.43
Iran	50.77	51.61	51.30	88.13	89.54	87.89
Ireland	76.86	79.66	79.85	118.71	122.36	123.19
Israel	61.67	60.92	62.76	100.90	100.43	102.06
Italy	77.10	76.30	71.22	118.99	118.42	112.52
Japan	55.17	56.04	56.98	93.28	94.72	94.91
Kenya	43.72	42.19	45.62	79.86	78.51	80.86
Mexico	77.33	76.72	78.05	119.26	118.92	120.97
Netherlands	54.44	53.92	54.23	92.43	92.24	91.51
New Zealand	64.24	64.01	65.10	103.91	104.04	104.95
Nigeria	32.48	33.42	34.80	66.69	68.25	67.48
Norway	88.61	87.63	82.08	132.48	131.68	125.95
Poland	61.63	61.83	63.47	100.86	101.49	102.94
Qatar	50.40	50.16	51.30	87.69	87.84	87.89
Romania	74.64	74.49	74.81	116.10	116.31	116.96
Singapore	67.21	66.51	67.45	107.40	106.97	107.86
Slovakia	55.81	54.98	57.38	94.03	93.48	95.41
South Africa	72.19	70.72	73.47	113.23	111.90	115.30
South Korea	68.83	67.94	70.36	109.29	108.64	111.46
Spain	63.72	62.65	62.94	103.30	102.45	102.28
Sweden	62.56	61.30	61.03	101.95	100.87	99.92
Syria	24.28	24.04	26.41	57.08	57.28	57.11
Taiwan	70.29	69.95	71.94	111.01	110.99	113.41
Tanzania	64.74	66.35	65.05	104.50	106.78	104.89
United Kingdom	62.02	63.38	60.70	101.31	103.31	99.51
USA	62.23	62.14	62.30	101.56	101.86	101.49
Venezuela	78.50	77.89	78.43	120.63	120.28	121.44
Yugoslavia	62.30	62.25	63.30	101.64	101.99	102.73

## 1.2. Measures

### 1.2.1. Study and sample characteristics

Relevant sample and study characteristics were taken from the individual publications. The raw mean, standard deviations of every raw mean, mean age of the participants, mean number of years of schooling, and gender were recorded (if available). The year of publication of the studies was also recorded.

### 1.2.2. Country-level characteristics

Relevant country-level characteristics were gathered from databases that the United Nations and other institutes provided on their websites. Gathered in this way were Gross National Product per capita in 2007 (GNP; *Gross Domestic Product*, 2007), and a number of characteristics related to the education in each country, such as illiteracy, rates of enrollment into education (the proportions of the population in a particular country that is enrolled in primary, secondary, and tertiary education), and the number of pupils per teacher (*Georgas et al.*, 2004).

In order to examine the dimensionality of the education-related characteristics at country level, illiteracy rate, enrollment into primary,

secondary, and tertiary education, and the number of pupils per teacher were factor analyzed. A first factor with an eigenvalue of 2.83 was found to explain 56% of the variance. Illiteracy rate had a loading of  $-.83$  on the factor, enrollment in primary education one of  $.09$ , enrollment into secondary education one of  $.93$ , enrollment into tertiary education a loading of  $.76$ , and the number of pupils per teacher a loading of  $-.83$ . The low loading of primary enrolment probably reflects the limited cross-country variability in this variable because of the universality of compulsory primary schooling. The factor covers a broad set of interrelated educational input and output factors and was labeled educational permeation.

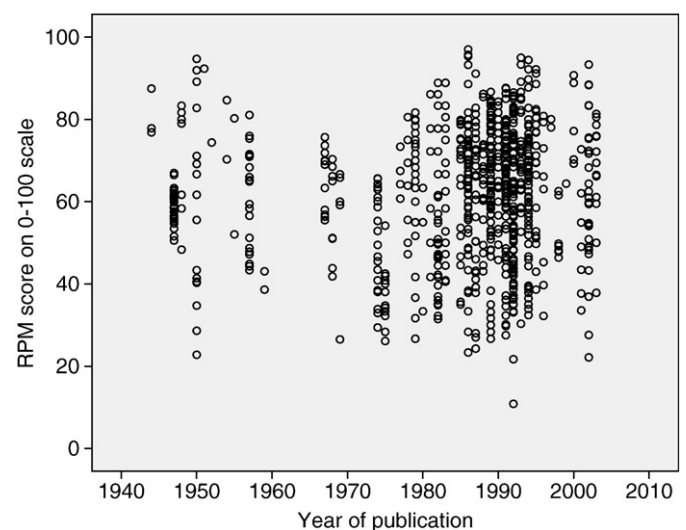
## 2. Results

### 2.1. Descriptives

All scores were transformed from their raw mean to a 0–100 scale, depending on the number of items that were administered in the particular samples. Table 2 presents the mean scores on a single scale and the mean IQ scores by country. Visual inspection shows a large variation in country means, but no country shows any sign of a ceiling effect. Across the 798 samples, mean scores on Raven's Progressive Matrices ranged from 10 to 97, with an overall mean of 61.88 and a standard deviation of 15.97. Standard deviations were available for 512 of the 798 samples; they ranged from 1.00 to 28.84, with a mean of 6.88 and a standard deviation of 3.09. Both chronological and educational age showed large ranges. Chronological age ranged from 3.00 to 82.50 years, with a mean of 16.72 and a standard deviation of 13.94; educational age ranged from 0 to 17.17 years, with a mean of 5.84 and a standard deviation of 3.89. Sex effects could not be addressed. Nine studies did not report participants' sex, while 485 samples had some mixture of both males and females and could not be further broken down. Of the 288 remaining samples, 175 samples were entirely composed of males and 113 of females.

### 2.2. Initial analyses

In order to estimate the effect of country on Raven performance, a univariate ANOVA was conducted with performance as the dependent variable and country as grouping variable. The effect of country on performance is significant,  $F(44, 753) = 4.79$ ,  $p < .001$ , partial  $\eta^2 = .22$ . *Cohen* (1988) proposed boundary values for small, medium, and large effects of  $.01$ ,  $.06$ , and  $.14$ , respectively. The effect size observed here is thus large. In order to estimate the effect of year of publication on Raven



**Fig. 1.** Performance on Raven's Progressive Matrices plotted against year of publication.



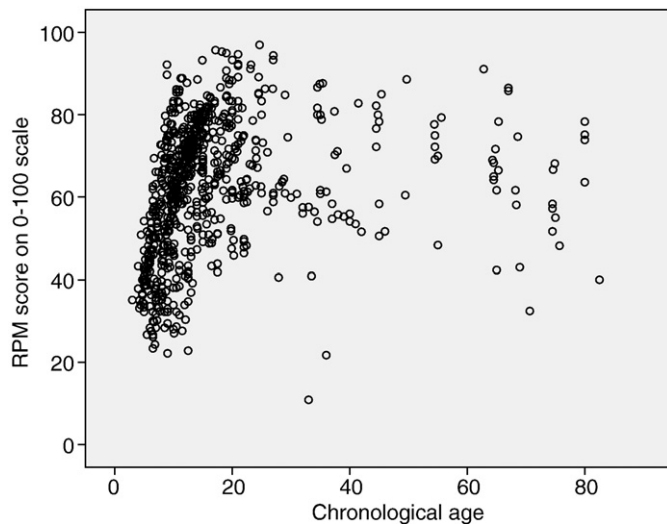


Fig. 2. Performance on Raven's Progressive Matrices plotted against chronological age.

performance, a univariate ANOVA with performance as the dependent variable and year of publication as the grouping variable was carried out. The effect of year of publication is significant,  $F(40, 757) = 3.55, p < .001$ , and large, partial  $\eta^2 = .16$ . Fig. 1 presents the pattern of performance over time. A visual inspection does not suggest a clear patterning despite the large effect size; mean performance does not look different for the 1950s than for the 1990s.

Figs. 2 and 3 visually present the change of performance on Raven's Progressive Matrices across chronological and educational age, respectively. The relationship between chronological age and performance corresponds to that what is typically found in the literature (e.g., McArdle, Ferrer-Caja, Hamagami, & Woodcock, 2002; Salthouse, 1996). There is a sharp increase of performance across childhood, adolescence, and early adulthood, which is followed by a gradual decline until old age. The lower scores among the older cohorts appear to be common across the three versions, although the APM shows the strongest effect (not further documented here). To what extent this finding is due to the relative small sample of APM studies will have to remain open. Another source of the lower scores seems to be the lower educational age of older cohorts, as explored below in more detail. Fig. 3 shows the relation between educational age and

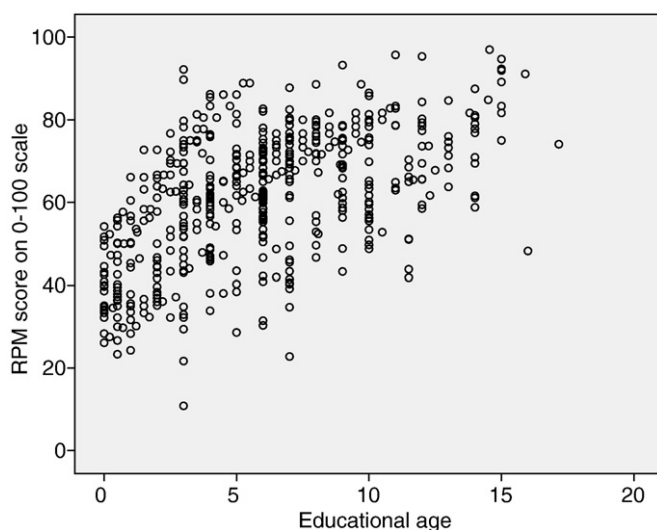


Fig. 3. Performance on Raven's Progressive Matrices plotted against educational age.

Table 3  
Correlations between sample-, country-, and study-level characteristics.

Characteristics	Chronological age < 20 yr	Chronological age > 20 yr	Educational age	GNP
Sample characteristics				
Educational age	.96***	-.24		
Country characteristics				
Gross National Product	-.01	-.00	.04	
Educational permeation	-.05	.10	.05	.79***
Study characteristics				
Year of publication	-.13**	.21**	-.19***	-.08*

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

performance. A positive association of test scores and educational age is clearly visible.

### 2.3. Correlational and regression analyses

Correlations between relevant sample, study, and country characteristics are presented in Table 3. Educational age correlated significantly with year of publication,  $r(514) = -.19, p < .001$ . The direction of the relation between educational age and year of publication is striking. More recent studies apparently sampled participants with on average lower educational ages than earlier studies. Until the age of twenty chronological age and educational age correlated almost perfectly,  $r(444) = .96, p < .001$ , but the correlation was (almost significantly) negative for people over the age of twenty,  $r(54) = -.24, p = .08$ . The lack of significance of this latter correlation is probably due to the small number of people aged older than twenty in the study samples. The relations between these characteristics and Raven performance are addressed in the next section.

Table 4 presents the correlations between Raven performance and seven of the sample, study, and country characteristics. As can be seen at the top of the Table, sample and country characteristics are significantly related. At sample level, both chronological age for people that are younger than 20 years and educational age correlated significantly with performance,  $r(614) = .23, p < .001$  and  $r(514) = .56, p < .001$ , respectively. At country level, educational permeation and Gross National Product correlated positively with performance on the Raven,  $r(709) = .25, p < .001$  and  $r(709) = .16, p < .001$ , respectively. These two positive correlations suggest that basic educational and everyday conditions of countries can statistically account for a relevant part of cross-cultural differences in performance on the Raven.

Table 4  
Correlations between performance on Raven's Progressive Matrices and sample-, country-, and study-level characteristics.<sup>a</sup>

Characteristics	R
Sample characteristics	
Chronological age < 20 yr	.58***
Chronological age > 20 yr	-.14
Educational age	.56***
Country characteristics	
Gross National Product	.16***
Educational permeation	.25***
Study characteristics	
Year of publication (original)	.07
Year of publication (partial) <sup>b</sup>	.22***

\*\*\* $p < .001$ .

<sup>a</sup> All scores were transformed from their raw mean to a 0–100 scale and then averaged across the Advanced, Colored, and Standard Versions.

<sup>b</sup> The partial correlation between year of publication and performance was corrected for educational age and educational permeation.

**Table 5**  
Size of the Flynn Effect by country (standardized regression coefficients).

Country	Frequency		$\beta$	$R^2$
	Number of years	Number of samples		
Australia	7	35	-.26	.33**
Canada	8	20	-.52**	.68***
Germany (West)	8	25	-.05	.40*
India	8	41	.62***	.44***
Iran	2	22	.64***	.95***
Poland	5	72	.55***	.60***
United Kingdom	14	129	.53***	.52***
United States	17	99	-.01	.20**

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

The Flynn effect would be observed if test performance and year of publication are positively associated. As can be seen in Fig. 1, the relation is weak (though marginally significant),  $r(798) = .07$ ,  $p = .05$ . The weakness of the relation could be a consequence of moderators not accounted for. More specifically, the educational situation of samples may be crucial, both in terms of participants' educational age as in terms of countries' educational permeation. Educational age was positively related to performance, but as shown in Table 3, educational age was negatively related to year of publication. When educational age and educational permeation were included as control variables in the estimation, the correlation between Raven performance and year of publication became .22 ( $p < .001$ ). Thus, after controlling for sample- and country-related educational characteristics, we observed the expected Flynn effect in performance on Raven's Progressive Matrices.

The importance of sample and country characteristics in moderating the Flynn effect is further underscored in a regression analysis. Performance on the Raven was the dependent variable, while year of publication, educational age, and educational permeation were predictors. The proportion of explained variance in performance is large,  $R^2 = .41$ ,  $p < .001$ . The relation between educational age and performance is strong and significant ( $\beta = .59$ ,  $p < .001$ ). Educational permeation has a somewhat smaller effect on performance, but the effect is still significant ( $\beta = .26$ ,  $p < .001$ ). A small, though salient Flynn effect can be derived from the positive relation between performance and year of publication ( $\beta = .18$ ,  $p < .001$ ). When converted to IQ points, this effect corresponds to an increase in IQ of 2.01 points per decade. The regression analysis demonstrates that while the zero-order correlations of our predictors with Raven performance are not significant, the regression coefficients (which might be viewed as partial correlations) are significant.

The regression analysis implicitly assumes the universality of the Flynn effect. A final analysis addressed this assumption in more detail by testing the presence of the Flynn effect in individual countries. A country was included in the analysis if data from this country met three criteria: The country should be present in the dataset with at least 20 samples; data of the country should be collected on at least two independent occasions; data of the country should have a minimum dispersion of 14 years from the earliest to the latest occasion. Eight out of the 45 countries in the dataset met all criteria (namely Australia, Canada, the former West-Germany, India, Iran, Poland, United Kingdom, and the United States). For each country, a separate regression analysis was conducted with year of publication and educational age as predictors and the Raven score as dependent variable. Results are presented in Table 5.

Canada showed a significantly negative regression coefficient for year of publication. This might signify a reversed Flynn effect. The United Kingdom was the only affluent country with a salient Flynn effect. The largest Flynn effects were found in India, Iran, and Poland. A closer examination of the raw country means confirmed that variation in the size of the Flynn effect is not caused by ceiling effects in the data, indicating that the present findings resemble actual variations in the

Flynn effect. The size of the Flynn effect showed a significantly negative correlation with the Gross National Product of the country,  $r(8) = -.74$ ,  $p < .05$ . Unfortunately, countries from Africa and South America were measured only once and hence, we do not know whether the negative correlation extends to developing countries. It may be concluded that our data suggest a temporal patterning in the Flynn effect. The effect was first observed in Western countries, but here it seems to have reached its ceiling. Countries with a lower though increasing level of economic development show a more pronounced Flynn effect.

### 3. Discussion

We examined the associations between performance on Raven's Progressive Matrices with various education-related country characteristics and year of publication. A total of 193 publications were included in our meta-analysis, which contained 798 independent samples from 45 countries and covered a period of 60 years. This considerable variation in countries and years of publication is crucial for testing the cross-cultural generalizability of the Flynn effect. A number of results emerged that would not have been evident when looking at the Flynn-effect as an isolated measure of individual differences.

There were two results that carry important conceptual implications. First, the regression analysis showed that year of publication has a relation with Raven performance independent of individuals' educational age and countries' educational permeation; Raven performance increases by 2.01 IQ points per decade. Moreover, educational age was the best predictor of Raven performance. These analyses suggest that The Flynn effect is not an artifact of the on average higher levels of education in countries where the economy is growing (that tend to invest more and more in education). The current study suggests that an increase in Raven performance is independently associated with three factors: educational permeation, educational age, and publication year. Two of these factors, educational age and educational permeation, will often act in concert; economic growth over an extended period will often lead to more educational permeation and to an increase of the average educational age of a population. If the Flynn effect would be observed in a country with a substantial economic development in the period of observation, the size of the Flynn effect may have been boosted by that economic development. This pattern of results suggests a more complex relationship between intelligence and wealth at country level than suggested by Lynn and Vanhanen (2002, 2006) and shows that explaining this relationship requires much caution (Hunt & Wittmann, 2008).

Second, the Flynn effect seems to be present in all countries represented in our meta-analysis, with variation in the effect confined to its size; yet, the generalizability of this second finding requires closer examination. One question that emerges after our analysis is whether our data set includes sufficient temporal and cross-cultural variation in order to assert the universality of the Flynn effect. It could be argued that a sample of 45 countries is sizeable; however, the cultural variation in the sample is not optimal. An inspection of Table 1 suggests that affluent Western countries and developing countries are overrepresented and it is only for some, mainly Western, countries that a sizeable variation in years of publication is available. As a consequence, one could argue that variability in our data set is limited. Still, our data suggest that Flynn effect is not linked to Western societies alone and is independent of individual-level and country-level education-related factors.

We found that the size of the Flynn effect is related to country affluence, with more affluent countries showing a smaller IQ increase. These findings suggest that the Flynn effect is a function of earlier levels of performance, in which new elements of information connect with already available elements of information. This finding has implications for current views on cross-cultural differences in abstract

thinking. Researchers tend to employ a distinction between information and processor when interpreting cross-cultural differences in intelligence scores. Information is seen by various researchers as the raw material that feeds in the mental processor (e.g., Luria, 1976; Rindermann, 2007). Alternatively, some consider information to constitute the stimulus that motivates access to the mental construct of abstract thinking (e.g., Ceci, 1991; Van de Vijver, 2002). The present findings question the validity of a sharp distinction between information and processor when interpreting cross-cultural differences in intelligence scores, since cross-cultural differences are confined neither to the information, nor to the processor. The finding of a gradual decline of the Flynn effect with increased affluence is more compatible with a view of a cognitive system in which new information builds on existing knowledge and procedures already available than with a view in which either the information or processor capacity create the Flynn effect.

The present findings suggest that pervasive cognitive variability is best thought of in terms of changing distributions of the ways in which people approach a problem, rather than stable differences between individuals or between cultures (Siegler, 1994). Each Raven item really is a task of inductive reasoning, for every individual after a certain age, but the method, strategies, and heuristics that people use in order to solve a problem is known to change from situation to situation, even for the same individual (Kahneman, Slovic, & Tversky, 1982; Siegler, 1994).

## References

- Blieszner, R., Willis, S. L., & Baltes, P. B. (1981). Training research in aging on the fluid ability of inductive reasoning. *Journal of Applied Developmental Psychology*, 2, 247–265.
- Cattell, R. B. (1940). A culture-free intelligence test, I. *Journal of Educational Psychology*, 31, 176–199.
- Cattell, R. B., & Cattell, A. K. S. (1963). *Culture Fair Intelligence Test*. Champaign, IL: Institute for Personality and Ability Testing.
- Ceci, S. J. (1991). How much does schooling influence general intelligence and its cognitive components? A reassessment of the evidence. *Developmental Psychology*, 27, 703–722.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.
- Colom, R., Lluis-Font, J. M., & Andres-Pueyo, A. (2005). The general intelligence gains are caused by decreasing variance in the lower half of the distribution: Supporting evidence from the nutrition hypothesis. *Intelligence*, 33, 83–91.
- Court, J. H. (1995). *A Researcher's Bibliography for Raven's Progressive Matrices and Mill Hill Vocabulary Scales*. [Computer software]. San Antonio, TX: Harcourt Assessment.
- Daley, T. C., Whaley, S. E., Sigman, M. D., Espinosa, M. P., & Neumann, C. (2003). IQ on the rise: The Flynn effect in rural Kenyan children. *Psychological Science*, 14, 215–219.
- Dasen, P. R. (Ed.). (1977). *Piagetian psychology. Cross-cultural contributions* (pp. 1–25). New York: Gardner.
- Flynn, J. R. (1987). Massive gains in 14 nations: What IQ tests really measure. *Psychological Bulletin*, 101, 171–191.
- Flynn, J. R. (2007). *What is intelligence? Beyond the Flynn effect*. London, UK: Cambridge University Press.
- Frijda, N. H., & Jahoda, G. (1966). On the scope and methods of cross-cultural research. *International Journal of Psychology*, 1, 109–127.
- Galotti, K. M. (1989). Approaches to studying formal and everyday reasoning. *Psychological Bulletin*, 105, 331–351.
- Georgas, J., Van de Vijver, F. J. R., & Berry, J. W. (2004). The ecocultural framework, ecosocial indices and psychological variables in cross-cultural research. *Journal of Cross-Cultural Psychology*, 35, 74–96.
- Gross Domestic Product (2007, October 20). Wikipedia, *The Free Encyclopedia* Retrieved October 22, 2007 from [http://en.wikipedia.org/wiki/Gross\\_domestic\\_product](http://en.wikipedia.org/wiki/Gross_domestic_product)
- Hunt, E., & Wittmann, W. (2008). National intelligence and national prosperity. *Intelligence*, 36, 1–9.
- Jensen, A. R. (1980). *Bias in mental testing*. New York: Free Press.
- Kahneman, D., Slovic, P., & Tversky, A. (1982). *Judgment under uncertainty: Heuristics and biases*. New York: Cambridge University Press.
- Luria, A. R. (1976). *Cognitive development: Its cultural and social foundations*. Cambridge, MA: Harvard University Press.
- Lynn, R. (1982). IQ in Japan and the United States shows a growing disparity. *Nature*, 297, 222–223.
- Lynn, R., & Vanhanen, T. (2002). *IQ and the wealth of nations*. Westport, CT: Praeger.
- Lynn, R., & Vanhanen, T. (2006). *IQ and global inequality*. Athens, GA: Washington Summit.
- McArdle, J. J., Ferrer-Caja, E., Hamagami, F., & Woodcock, R. W. (2002). Comparative longitudinal structural analyses of the growth and decline of multiple intellectual abilities over the life span. *Developmental Psychology*, 38, 115–142.
- Ombredane, A., Robaye, F., & Plumail, H. (1956). Résultats d'une application répétée du matrix-couleur à une population de Noirs Congolais [Results of a repeated administration of the color-matrix test to Congo Blacks]. *Bulletin du C.E.R.P.*, 6, 129–147.
- Raven, J. (2000). The Raven's Progressive Matrices: Change and stability over culture and time. *Cognitive Psychology*, 41, 1–48.
- Raven, J. C. (1938). *Progressive Matrices: A perceptual test of intelligence, 1938, sets A, B, C, D, and E*. London: H. K. Lewis.
- Raven, J. C. (1956). *Progressive Matrices, sets A, B, C, D and E*. London: H. K. Lewis.
- Rindermann, H. (2007). The g-factor of international cognitive ability comparisons: The homogeneity of results in PISA, TIMSS, PIRLS and IQ-tests across nations. *European Journal of Personality*, 21, 667–787.
- Rushton, J. P., Skuy, M., & Bons, T. A. (2004). Construct validity of Raven's advanced progressive matrices for African and non-African engineering students in South Africa. *International Journal of Selection and Assessment*, 12, 220–229.
- Salthouse, T. A. (1996). The processing-speed theory of adult age differences in cognition. *Psychological Review*, 103, 403–428.
- Schooler, C. (1998). Environmental complexity and the Flynn effect. In U. Neisser (Ed.), *The rising curve: Long-term gains in IQ and related measures* (pp. 67–79). Washington, DC: American Psychological Association.
- Siegler, R. S. (1994). Cognitive variability: A key to understanding cognitive development. *Current Directions in Psychological Science*, 3, 1–5.
- Sternberg, R. J., Grigorenko, E. L., Ngorosho, D., Tantufuye, E., Mbiase, A., Nokes, C., et al. (2002). Assessing intellectual potential in rural Tanzanian school children. *Intelligence*, 30, 141–162.
- Te Nijenhuis, J., Van Vianen, A. E. M., & Van der Flier, H. (2007). Score gains on g-loaded tests: No g. *Intelligence*, 35, 283–300.
- Van de Vijver, F. J. R. (1997). Meta-analysis of cross-cultural comparisons of cognitive test performance. *Journal of Cross-Cultural Psychology*, 28, 678–709.
- Van de Vijver, F. J. R. (2002). Inductive reasoning in Zambia, Turkey and the Netherlands: Establishing cross-cultural equivalence. *Intelligence*, 30, 313–351.
- Van de Vijver, F. J. R., & Leung, K. (1997). *Methods and data analysis for cross-cultural research*. Newbury Park, CA: Sage.
- Vernon, P. E. (1979). *Intelligence: Heredity and environment*. San Francisco: Freeman.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.
- Williams, W. M. (1998). Are we raising smarter children today? School- and home-related influences on IQ. In U. Neisser (Ed.), *The rising curve: Long-term gains in IQ and related measures* (pp. 125–154). Washington, DC: American Psychological Association.
- Wing, H. (1980). Practice effects with traditional mental test items. *Applied Psychological Measurement*, 4, 141–155.

## Studies used in the meta-analysis

- Abdel-Khalek, A. M. (1988). Egyptian results on the Standard Progressive Matrices. *Personality and Individual Differences*, 9, 193–195.
- Alderton, D. L., & Larson, G. E. (1990). Dimensionality of Raven's Advanced Progressive Matrices items. *Educational and Psychological Measurement*, 50, 887–900.
- Amador-Campos, J. A., & Kirchner-Nebo, T. (2001). Children's Embedded Figures Test and Matching Familiar Figures Test-20: Factorial structure for boys and girls from 6 to 11 years old. *Perceptual and Motor Skills*, 93, 709–712.
- Andreasen, N. C. (1987). Creativity and mental illness: Prevalence rates in writers and their first-degree relatives. *American Journal of Psychiatry*, 144, 1288–1292.
- Arthur, W., Jr., Barret, G. V., & Doverspike, D. (1990). Validation of an information-processing-based test battery for the prediction of handling accidents among petroleum-product transport drivers. *Journal of Applied Psychology*, 75, 621–628.
- Arthur, W., & Day, D. V. (1994). Development of a short form for the Raven Advanced Progressive Matrices. *Educational and Psychological Measurement*, 54, 394–403.
- Arthur, W., & Olson, E. (1991). Computer attitudes, computer experience, and their correlates: An investigation of path linkages. *Teaching of Psychology*, 18, 51–54.
- Backhoff-Escudero, E. (1992). Normas estadísticas hispanas de tests psicológicos: Son adecuadas para la población mexicana? [Hispanic statistical norms of psychological tests: Are they appropriate for Mexican populations?] *Revista Mexicana de Psicología*, 9, 117–125.
- Baraheni, M. N. (1974). Raven's Progressive Matrices as applied to Iranian children. *Educational and Psychological Measurement*, 34, 983–988.
- Barker, T. A., Torgesen, J. K., & Wagner, R. K. (1992). The role of orthographic processing skills on five different reading tasks. *Reading Research Quarterly*, 27, 335–346.
- Bart, W. M., Kamal, A., & Lane, J. F. (1987). The development of proportional reasoning in Qatar. *Journal of Genetic Psychology*, 148, 95–103.
- Basso, A., Capitani, E., & Laiacina, M. (1987). Raven's Colored Progressive Matrices: Normative values on 305 adult normal controls. *Functional Neurology*, 2, 189–194.
- Bhogle, S., & Prakash, I. J. (1992). Performance of Indian children on the Coloured Progressive Matrices. *Psychological Studies*, 37, 178–181.
- Bhogle, S., & Prakash, I. J. (1994). Normative data on Advanced Progressive Matrices for Indian university students. *Indian Journal of Clinical Psychology*, 21, 53–57.
- Bishop, D., Hartley, J., & Weir, F. (1994). Why and when do some language-impaired children seem talkative? A study of initiation in conversations of children with semantic-pragmatic disorder. *Journal of Autism and Developmental Disorders*, 24, 177–197.
- Bolin, B. J. (1955). A comparison of Raven's Progressive Matrices (1938) with the ACE Psychological Examination and the Otis Gamma Mental Ability Test. *Journal of Consulting Psychology*, 19, 400.
- Borkowski, J. G., & Krause, A. (1983). Racial differences in intelligence: The importance of the executive system. *Intelligence*, 7, 379–395.
- Bors, D. A., & Forrin, B. (1995). Age, speed of information processing, recall, and fluid intelligence. *Intelligence*, 20, 229–248.
- Bors, D. A., MacLeod, C. M., & Forrin, B. (1993). Eliminating the IQ-RT correlation by eliminating an experimental confound. *Intelligence*, 17, 475–500.



- Bors, D. A., & Stokes, T. L. (1998). Raven's Advanced Progressive Matrices: Norms for first-year university students and the development of a short form. *Educational and Psychological Measurement*, 58, 382–398.
- Bosman, A. M. T. (1994). *Reading and spelling in children and adults: Evidence for a single-route model*. The Netherlands: University of Amsterdam Unpublished doctoral dissertation.
- Bosman, A. M. T., & de Groot, A. M. B. (1992). Differential effectiveness of reading and non-reading tasks in learning to spell. In F. Satow & B. Gatherer (Eds.), *Literacy without frontiers* (pp. 279–289). Widnes, UK: United Kingdom Reading Association.
- Bosman, A. M. T., & de Groot, A. M. B. (1995). Evidence for assembled phonology in beginning and fluent readers as assessed with the first-letter-naming task. *Journal of Experimental Child Psychology*, 59, 234–259.
- Bosman, A. M. T., & de Groot, A. M. B. (1996). Phonologic mediation is fundamental to reading: Evidence from beginning readers. *Quarterly Journal of Experimental Psychology*, 49, 715–744.
- Bosman, A. M. T., & van Leerdam, M. (1993). Aanvankelijk spellen: De dominantie van de verklankende spelwijze en de geringe effectiviteit van lezen als spellinginstructiemethode [Beginning spelling: Prevalence of the phonological strategy in spelling and the scant effectivity of reading as a spelling instruction method]. *Pedagogische Studien*, 70, 28–45.
- Bromley, D. B. (1991). Aspects of written language production over adult life. *Psychology and Aging*, 6, 296–308.
- Bruck, M., & Genesee, F. (1995). Phonological awareness in young second language learners. *Journal of Child Language*, 22, 307–324.
- Buckhalt, J. A., & Jensen, A. R. (1989). The British Ability Scales Speed of Information Processing subtest: What does it measure? *British Journal of Educational Psychology*, 59, 100–107.
- Cantwell, Z. M. (1986). Assessment of developed general intellectual ability with nonverbal measures. *Journal of Psychology*, 120, 473–478.
- Carlesimo, G. A., Marfia, G. A., Loasses, A., & Caltagirone, C. (1996). Recency effect in anterograde amnesia: Evidence for distinct memory stores underlying enhanced retrieval of terminal items in immediate and delayed recall paradigms. *Neuropsychologia*, 34, 177–184.
- Cerella, J., DiCara, R., Williams, D., & Bowles, N. (1986). Relations between information processing and intelligence in elderly adults. *Intelligence*, 10, 75–91.
- Chan, J., & Lynn, R. (1989). The intelligence of six-year-olds in Hong Kong. *Journal of Biosocial Science*, 21, 461–464.
- Costenbader, V., & Ngari, S. M. (2001). A Kenya standardization of the Raven's Coloured Progressive Matrices. *School Psychology International*, 22, 258–268.
- Creed, P. A., & Wiener, K. K. (1999). Use of the Shipley Institute of Living Scale and the Raven's Standard Progressive Matrices with unemployed populations. *Journal of Applied Health Behaviour*, 1, 22–26.
- Cunningham, A. E., & Stanovich, K. E. (1991). Tracking the unique effects of print exposure in children: Associations with vocabulary, general knowledge, and spelling. *Journal of Educational Psychology*, 83, 264–274.
- Czerniawska, E. (1992). Samoregulacja w uczeniu się tekstów podręcznikowych i inne wybrane aspekty funkcjonowania poznawczego uczniów a ich osiągnięcia szkolne [Strategies for learning textbook texts and other selected aspects of pupils' cognitive functioning in relation to school achievements]. *Psychologia Wychowawcza*, 35, 130–144.
- Czerniawska, E. (1994). Zmiany rozwojowe w strategiach uczenia się tekstów podręcznikowych w uczeniu starszych klas szkoły podstawowej [Developmental changes in strategies for learning school texts in students of the higher primary school grades]. *Psychologia Wychowawcza*, 37, 46–55.
- Czerniawska, E. (1995). Korelaty gietkosci/szywnosci strategicznej wuczeniu sie tekstow podrecznikowych [Correlates of strategic flexibility/rigidity in school text learning]. *Psychologia Wychowawcza*, 38, 56–65.
- Davies, S., Bishop, D., Manstead, A. S. R., & Tantam, D. (1994). Face perception in children with autism and Asperger's syndrome. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, 35, 1033–1057.
- Deary, I. J. (1995). Auditory inspection time and intelligence: What is the direction of causation? *Developmental Psychology*, 31, 237–250.
- Deary, I. J., Caryl, P. G., Egan, V., & Wight, D. (1989). Visual and auditory inspection time: Their interrelationship and correlations with IQ in high ability subjects. *Personality and Individual Differences*, 10, 525–533.
- Deary, I. J., Starr, J. M., & MacLennan, W. J. (1998). Fluid intelligence, memory and blood pressure in cognitive aging. *Personality and Individual Differences*, 25, 605–619.
- DeShon, R. P., Chan, D., & Weissbein, D. A. (1995). Verbal overshadowing effects on Raven's Advanced Progressive Matrices: Evidence for multidimensional performance determinants. *Intelligence*, 21, 135–155.
- Diaz, A., Belena, A., & Baguena, M. (1994). The role of gender in juvenile delinquency: Personality and intelligence. *Personality and Individual Differences*, 16, 309–314.
- Diemand, A., Schuler, H., & Stapf, K. H. (1991). Zum Einsatz eines Lerntests bei Ingenieurstudenten: Eine Pilotstudie. *Psychologie und Praxis*, 35, 15–22.
- Diesfeldt, H. F. A., & Vink, M. T. (1989). Visuele patroonanalyse en redeneren: Raven's Coloured Progressive Matrices bij volwassenen van hoge tot zeer hoge leeftijd [Visual pattern analysis and reasoning: Raven's Colored Progressive with adults of old to very old age]. *Tijdschrift voor Gerontologie en Geriatrie*, 20, 241–247.
- Dobbins, D. A. (1988). Yule's "hump" revisited. *British Journal of Educational Psychology*, 58, 338–344.
- Dobbins, D. A., & Tafa, E. (1991). The "stability" of identification of underachieving readers over different measures of intelligence and reading. *British Journal of Educational Psychology*, 61, 155–163.
- Edholm, O. G., & Gibson, Q. H. (1944). Examination results and an intelligence test. *Lancet*, 247, 294–296.
- Egan, M., & Bunting, B. (1991). The effects of coaching on 11+ scores. *British Journal of Educational Psychology*, 61, 85–91.
- Fahrmeier, E. D. (1975). The effect of school attendance on intellectual development in northern Nigeria. *Child Development*, 46, 281–285.
- Ferjencik, J. (1992, July). Quantitative and qualitative differences in solving the Colored Progressive Matrices by Slovak and Gypsy children. *Paper presented at the 25th International Congress of Psychology, Brussels, Belgium*.
- Fernandez-Ballesteros, R., & Calero, M. D. (1993). Measuring learning potential. *International Journal of Cognitive Education and Mediated Learning*, 3, 9–21.
- Fernandez-Ballesteros, R., & Calero, M. D. (1995). Training effects on intelligence of older persons. *Archives of Gerontology and Geriatrics*, 20, 135–148.
- Fjeldsenden, B. (2002). *Nature, culture, child rearing, and cognition*. Retrieved on December 3, 2002, from The Norwegian University of Science and Technology Web site: <http://www.sv.ntnu.no/psy/bjarne/fjeldsenden/Articles/GHANAN98>
- Foulds, G. A., & Raven, J. C. (1948). Normal changes in the mental abilities of adults as age advances. *Journal of Mental Science*, 94, 133–142.
- Foulds, G. A., & Raven, J. C. (1950). An experimental survey with Progressive Matrices (1947). *British Journal of Educational Psychology*, 20, 104–110.
- Gallagher, S. A. (1989). Predictors of SAT mathematics scores of gifted male and gifted female adolescents. *Psychology of Women Quarterly*, 13, 191–203.
- Gathercole, S. E. (1995). The assessment of phonological memory skills in preschool children. *British Journal of Educational Psychology*, 65, 155–164.
- Gathercole, S. E., & Adams, A. (1994). Children's phonological working memory: Contributions of long-term knowledge and rehearsal. *Journal of Memory and Language*, 33, 672–688.
- Gathercole, S. E., Adams, A., & Hitch, G. J. (1994). Do young children rehearse? An individual-differences analysis. *Memory and Cognition*, 22, 201–207.
- Gathercole, S. E., & Willis, C. (1991). Differentiating phonological memory and awareness of rhyme: Reading and vocabulary development in children. *British Journal of Psychology*, 82, 387–406.
- Ghassemzadeh, H. (1988). A pilot study of the Bender-Gestalt test in a sample of Iranian normal children. *Journal of Clinical Psychology*, 44, 787–792.
- Gibson, Q. H. (1948). Intelligence tests and university careers of medical students. *Lancet*, 255, 323–324.
- Grady, C. L., Haxby, J. V., Horwitz, B., Berg, G., & Rapoport, S. I. (1987). Neuropsychological and cerebral metabolic function in early vs late onset dementia of the Alzheimer type. *Neuropsychologia*, 25, 807–816.
- Green, K. E., & Kluever, R. C. (1991). Structural properties of Raven's Colored Progressive Matrices for a sample of gifted children. *Perceptual and Motor Skills*, 72, 59–64.
- Guthke, J., & Al Zoubi, A. (1987). Kulturspezifische Differenzen in den Coloured Progressive Matrices (CPM) und in einer Lerntestvariante der CPM [Culture-specific differences in the Colored Progressive Matrices (CPM) and in a learning-test variant of the CPM]. *Psychologie in Erziehung und Unterricht*, 34, 306–311.
- Haier, R. J., Siegel, B. V., Jr., Nuechterlein, K. H., Hazlett, E., Wu, J. C., Paek, J., et al. (1988). Cortical glucose metabolic rate correlates of abstract reasoning and attention studied with Positron Emission Tomography. *Intelligence*, 12, 199–217.
- Haier, R. J., Siegel, B., Tang, T., Abel, L., & Buchsbaum, M. S. (1992). Intelligence and changes in regional cerebral glucose metabolic rate following learning. *Intelligence*, 16, 415–426.
- Hakuta, K. (1987). Degree of bilingualism and cognitive ability in mainland Puerto Rican children. *Child Development*, 58, 1372–1388.
- Hobson, R. P., Ouston, J., & Lee, A. (1989). Recognition of emotion by mentally retarded adolescents and young adults. *American Journal on Mental Retardation*, 93, 434–443.
- Holobow, N. E., Genesee, F., Lambert, W. E., Gastright, J., & Met, M. (1987). Effectiveness of partial French immersion for children from different social class and ethnic backgrounds. *Applied Psycholinguistics*, 8, 137–152.
- Huang, H. S., & Hanley, J. R. (1994). Phonological awareness and visual skills in learning to read Chinese and English. *Cognition*, 54, 73–98.
- Jachuck, K. (1982). Patterns of cognitive ability among boys in four sub-cultural groups. In R. Rath H. S. Asthana D. Sinha & J. B. H. Sinha (Eds.), *Diversity and unity in cross-cultural psychology* (pp. 60–69). Lisse, The Netherlands: Swets & Zeitlinger.
- Jaworowska, A., & Szustrowa, T. (1991). *Podrecznik do Testu Matryc Ravena. Aneks. Wersja Standard (1956). Polska standaryzacja 1991 (dorosl)*. Raven's Progressive Matrices Manual. Standard Version (1956). Polish standardization 1991 (adults). Warsaw, Poland: Polish Psychological Association.
- Jaworowska, A., & Szustrowa, T. (1991). *Raven's Progressive Matrices Manual. Standard Version (1956). Polish Standardization 1989 (5;11-15;11)*. Warsaw, Poland: Polish Psychological Association.
- Jensen, A. R. (1991). Speed of elementary cognitive processes: A chronometric anchor for psychometric tests of g. *Psychological Test Bulletin*, 4, 59–70.
- Jensen, A. R. (1993). Spearman's hypothesis tested with chronometric information-processing tasks. *Intelligence*, 17, 47–77.
- Jensen, A. R., Saccuzzo, D. P., & Larson, G. E. (1988). Equating the Standard and Advanced forms of the Raven Progressive Matrices. *Educational and Psychological Measurement*, 48, 1091–1095.
- Jensen, A. R., & Whang, P. A. (1993). Reaction times and intelligence: A comparison of Chinese-American and Anglo-American children. *Journal of Biosocial Science*, 25, 397–410.
- Kaniel, S., & Fisherman, S. (1991). Level of performance and distribution of errors in the Progressive Matrices test: A comparison of Ethiopian immigrant and native Israeli adolescents. *International Journal of Psychology*, 26, 25–33.
- Klauser, K. J. (1992). Wie verändert das induktive Denken älterer Menschen als Funktion des Trainingsniveaus? [How does cognitive training improve inductive reasoning of the elderly as a function of amount of training?] *Zeitschrift für Gerontopsychologie und -Psychiatrie*, 5, 141–153.
- Klauser, K. J. (1993). Über die Auswirkungen eines Trainings zum induktiven Denken auf zentrale Komponenten der Fremdsprachenlernfähigkeit [On the effects of an inductive reasoning training upon essential components of the ability to learn foreign languages]. *Zeitschrift für Pädagogische Psychologie*, 7, 1–9.

- Klauser, K. J. (1994). Über den Einfluss eines Trainings zum induktiven Denken auf Variablen der fluiden Intelligenz und des Lernens bei Älteren Menschen [On the impact of an inductive reasoning training on variables of fluid intelligence and learning of academic subject matter in the older adults]. *Zeitschrift für Gerontopsychologie und -Psychiatrie*, 7, 29–46.
- Klauser, K. J. (1996). Denktraining oder Lesetraining? Über die Auswirkungen eines Trainings zum induktiven Denken sowie eines Lesetrainings auf Leseverständnis und induktives Denken [Training to reason or training to read? The effects of training in inductive reasoning and in reading comprehension on inductive reasoning and reading comprehension]. *Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie*, 28, 67–89.
- Klauser, K. J. (1996). Begünstigt induktives Denken das Lösen komplexer Probleme? [Does inductive reasoning favor the solution of complex problems?] *Zeitschrift für Experimentelle Psychologie*, 43, 85–113.
- Klauser, K. J. (1997). Lässt sich die Strategie des induktiven Denkens auf schulisches Lernen transferierbar lehren? [Can the strategy to reason inductively be taught such that it transfers to learning of school-type material?] *Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie*, 29, 225–241.
- Kline, P., Draycott, S. G., & McAndrew, V. M. (1994). Reconstructing intelligence: A factor analytic study of the BIP. *Personality and Individual Differences*, 16, 529–536.
- Klingelhofer, E. L. (1967). Performance of Tanzanian secondary school pupils on the Raven Standard Progressive Matrices test. *Journal of Social Psychology*, 72, 205–215.
- Klippel, M. D. (1975). Measurement of intelligence among three New Zealand ethnic groups: Product versus process approaches. *Journal of Cross-Cultural Psychology*, 6, 365–376.
- Kollarik, K., & Marusicova, E. (1994). Stabilita vykonov ziaikov zakladnej skoly v intelektovych skuskach [The stability of elementary school students' performance on intelligence tests]. *Psychologia a Patopsychologia Dietata*, 29, 313–322.
- Kranzler, J. H. (1994). Application of the techniques of mental chronometry to the study of learning disabilities. *Personality and Individual Differences*, 16, 853–859.
- Kranzler, J. H., Whang, P. A., & Jensen, A. R. (1994). Task complexity and the speed and efficiency of Elemental Information Processing: Another look at the nature of Intellectual Giftedness. *Contemporary Educational Psychology*, 19, 447–459.
- Kumari, V., & Corr, P. J. (1998). Trait anxiety, stress and the menstrual cycle: Effects on Raven's Standard Progressive Matrices test. *Personality and Individual Differences*, 24, 615–623.
- Kuroda, J. (1959). Application of the Colored Progressive Matrices Test for the Japanese kindergarten children. *Psychologia*, 2, 173–177.
- Langsford, P. B., MacKenzie, B. D., & Maher, D. P. (1994). Auditory inspection time, sustained attention, and the fundamentality of mental speed. *Personality and Individual Differences*, 16, 487–497.
- Larson, G. E., & Alderton, D. L. (1990). Reaction time variability and intelligence: A "worst performance" analysis of individual differences. *Intelligence*, 14, 309–325.
- Larson, G. E., Merritt, C. R., & Williams, S. E. (1988). Information processing and intelligence: Some implications of task complexity. *Intelligence*, 12, 131–147.
- Larson, G. E., & Saccuzzo, D. P. (1989). Cognitive correlates of general intelligence: Toward a process theory of g. *Intelligence*, 13, 5–31.
- Leibovich de Figueroa, N. B., & Schufer de Paikín, M. L. (1992). La prueba "Matrices Coloredas" (Escala especial): Como evaluarla e interpretarla en nuestro medio [Raven's "Colored Matrices" (Special scale): Guideline to an evaluation and interpretation in an Argentine milieu]. *Acta Psiquiátrica y Psicológica de América Latina*, 38, 147–158.
- Levine, B., & Iscoe, I. (1954). A comparison of Raven's Progressive Matrices (1938) with a short form of the Wechsler-Bellevue. *Journal of Consulting Psychology*, 18, 10.
- Libran, E. C. (1997). La invarianza en la estructura factorial del Raven en grupos de delinquentes y no delinquentes [Invariance in factorial structure of Raven test in delinquent and nondelinquent groups]. *Psicothema*, 9, 47–55.
- Lim, T. K. (1988). Relationships between standardized psychometric and Piagetian measures of intelligence at the Formal Operations level. *Intelligence*, 12, 167–182.
- Lim, T. K. (1994). Gender-related differences in intelligence: Application of confirmatory factor analyses. *Intelligence*, 19, 179–192.
- Lugomer, G., & Zarevski, P. (1985). Intellectual functioning of elementary-school pupils of different sex. *Studia Psychologica*, 27, 29–35.
- Luszcz, M. A. (1992). Predictors of memory in young-old and old-old adults. *International Journal of Behavioral Development*, 15, 147–166.
- Lynn, R. (1994). The intelligence of Ethiopian immigrant and Israeli adolescents: A comment on Kaniel and Fisherman. *International Journal of Psychology*, 29, 55–56.
- Lynn, R. (2002). Sex differences on the progressive matrices among 15–16 year olds: Some data from South Africa. *Personality and Individual Differences*, 33, 669–673.
- Lynn, R., Pagliari, C., & Chan, J. (1988). Intelligence in Hong Kong measured for Spearman's g and the visuospatial and verbal primaries. *Intelligence*, 12, 423–433.
- Lynn, R., & Shigehisa, T. (1991). Reaction times and intelligence: A comparison of Japanese and British children. *Journal of Biosocial Science*, 23, 409–416.
- Lynn, R., & Song, M. J. (1994). General intelligence, visuospatial and verbal abilities in Korean children. *Personality and Individual Differences*, 16, 363–364.
- Ma, H. K., & Leung, M. C. (1991). Altruistic orientation in children: Construction and validation of the child altruism inventory. *International Journal of Psychology*, 26, 745–759.
- Macdonald, H. A., & Netherton, A. H. (1969). Contribution of a non-verbal general ability test to the educational assessment of pupils in the cross-cultural setting of the Canadian North. *Journal of Educational Research*, 62, 315–319.
- Mare, E. (1986). Aspecte diferentiale in conduita elevilor si studentilor cu performante superioare [Different aspects in the behavior of pupils and students with superior performance]. *Revista de Psihologie*, 32, 111–118.
- Martin, M., Ewert, O., & Schwanenflugel, P. J. (1994). The role of verbal ability in the processing of complex verbal information. *Psychological Research*, 56, 301–309.
- Martin, A. W., & Wiechers, J. E. (1954). Raven's Colored Progressive Matrices and the Wechsler Intelligence Scale for Children. *Journal of Consulting Psychology*, 18, 143–144.
- McKay, P. F., Doverspike, D., Bowen-Hilton, D., & Martin, Q. D. (2002). Stereotype threat effects on the Raven Advanced Progressive Matrices scores of African Americans. *Journal of Applied Psychology*, 32, 767–787.
- Measso, G., Zappala, G., Cavarzeran, F., Crook, T. H., Romani, L., Pirozzolo, F. J., et al. (1993). Raven's Colored Progressive Matrices: A normative study of a random sample of healthy adults. *Acta Neurologica Scandinavica*, 88, 70–74.
- Mohanty, A. K. (1982). Cognitive development of tribal children from unilingual and bilingual environments. In R. Rath H. S., Asthana D. Sinha & J. B. H. Sinha (Eds.), *Diversity and unity in cross-cultural psychology* (pp. 78–86). Lisse, The Netherlands: Swets & Zeitlinger.
- Morales de Barbenza, C., & Sans de Uhrland, M. (1990). Estilos cognitivos, capacidad intelectual y personalidad [Cognitive styles, intellectual capacity, and personality]. *Arquivos Brasileiros de Psicologia*, 42, 134–142.
- Morris, G. L., & Alcorn, M. B. (1995). Raven's Progressive Matrices and inspection time: P200 slope correlates. *Personality and Individual Differences*, 18, 81–87.
- Mukerjee, M., Chatterji, S., & Gupta, R. (1991). Factors of prolonged deprivation, intelligence level and academic achievement. *Psychological Studies*, 36, 20–24.
- Murphy, D. G. M., Allen, G., Haxby, J. V., Largay, K. A., Daly, E., White, B. J., et al. (1994). The effects of sex steroids, and the X chromosome, on female brain function: A study of the neuropsychology of adult Turner syndrome. *Neuropsychologia*, 32, 1309–1323.
- Neubauer, A. C. (1990). Selective reaction times and intelligence. *Intelligence*, 14, 79–96.
- Neubauer, A. C. (1990). Speed of information processing in the Hick paradigm and response latencies in a psychometric intelligence test. *Personality and Individual Differences*, 11, 147–152.
- Neubauer, A. C. (1991). Intelligence and RT: A modified Hick paradigm and a new RT paradigm. *Intelligence*, 15, 175–192.
- Neubauer, A. C., Bauer, C., & Holler, G. (1992). Intelligence, attention, motivation and speed-accuracy trade-off in the Hick Paradigm. *Personality and Individual Differences*, 13, 1325–1332.
- Neubauer, A. C., & Freudenthaler, H. H. (1994). Reaction times in a sentence-picture verification test and intelligence: Individual strategies and effects of extended practice. *Intelligence*, 19, 193–218.
- Neubauer, A. C., Urban, E., & Malle, B. F. (1991). Raven's Advanced Progressive Matrices: Computerunterstützte präsentation versus standardvorgabe [Raven's Advanced Progressive Matrices: Computer supported versus standard presentation]. *Diagnostica*, 37, 204–212.
- Newnham, C., & McKenzie, B. E. (1993). Cross-modal transfer of sequential visual and haptic shape information by clumsy children. *Perception*, 22, 1061–1073.
- Niaz, M., & Suad de Nunez, G. (1991). The relationship of mobility-fixity to creativity, formal reasoning, and intelligence. *Journal of Creative Behavior*, 25, 205–217.
- Nkaya, H. N., Huteau, M., & Bonnet, J. P. (1994). Retest effect on cognitive performance on the Raven-38 Matrices in France and in the Congo. *Perceptual and Motor Skills*, 78, 503–510.
- Novackova, J. (1988). Podíl jednotlivých psychologických metod užitých při predškolském prohlídce na predikci školní úspěšnosti dítěte [Contribution of psychological methods used in the preschool examination to the prediction of the child's academic achievement]. *Ceskoslovenská Psychologie*, 32, 117–126.
- Olsen, J. (1992). Evaluating young children's cognitive capacities through computer versus hand drawings. *Scandinavian Journal of Psychology*, 33, 193–211.
- Olsson, H., Björkman, C., Haag, K., & Juslin, P. (1998). Auditory inspection time: On the importance of selecting the appropriate sensory continuum. *Personality and Individual Differences*, 25, 627–634.
- On, T. K., & Watkins, D. (1994). Daily living and study habits and the academic achievement of secondary school students in Hong Kong. *Perceptual and Motor Skills*, 79, 231–234.
- Ortiz, T., & Maojo, V. (1993). Comparison of the P300 wave in introverts and extraverts. *Personality and Individual Differences*, 15, 109–112.
- Orton, R., & Martin, D. R. (1948). Psychiatric screening of medical students. *Lancet*, 255, 321–323.
- Owen, K. (1992). The suitability of Raven's Standard Progressive Matrices for various groups in South Africa. *Personality and Individual Differences*, 13, 149–159.
- Paine, P., Garrofe Dorea, J., Pasquali, L., & Mauricio Monteiro, A. (1992). Growth and cognition in Brazilian schoolchildren: A spontaneously occurring intervention study. *International Journal of Behavioral Development*, 15, 169–183.
- Pajares, F., & Kranzler, J. (1995). Self-efficacy beliefs and general mental ability in mathematical problem-solving. *Contemporary Educational Psychology*, 20, 426–443.
- Papagno, C., & Vallar, G. (1995). Verbal short-term memory and vocabulary learning in polyglots. *Quarterly Journal of Experimental Psychology*, 48, 98–107.
- Patnaik, N., & Rath, R. (1982). Effect of cognitive training on the achievement of socially disadvantaged low achievers. In R. Rath H. S., Asthana D. Sinha & J. B. H. Sinha (Eds.), *Diversity and unity in cross-cultural psychology* (pp. 87–96). Lisse, The Netherlands: Swets & Zeitlinger.
- Paul, S. M. (1985). The Advanced Raven's Progressive Matrices: Normative data for an American University population and an examination of the relationship with Spearman's g. *Journal of Experimental Education*, 54, 95–100.
- Phillips, L. H., & Rabbitt, P. M. A. (1995). Impulsivity and speed-accuracy strategies in intelligence. *Intelligence*, 21, 13–29.
- Pind, J., Gunnarsdóttir, E. K., & Jóhannesson, H. S. (2003). Raven's Standard Progressive Matrices: new school age norms and a study of the test's validity. *Personality and Individual Differences*, 34, 375–386.
- Pitariu, H. (1986). Analiza de itemi si standardizarea matricolor progresive avansate (MPA) [Item analysis and standardization of advanced progressive matrices (APM)]. *Revista de Psihologie*, 32, 33–43.
- Polich, J., & Martin, S. (1992). P300, cognitive capability, and personality: A correlational study of university undergraduates. *Personality and Individual Differences*, 13, 533–543.



- Powers, S., & Barkan, J. H. (1968). Concurrent validity of the Standard Progressive Matrices for Hispanic and non-Hispanic seventh-grade students. *Psychology in the Schools*, 23, 333–336.
- Preussler, W. (1993). Die Bedeutung des Kontexts für das episodische Gedächtnis bei jüngeren und älteren Menschen [The importance of context for episodic memory in younger and older persons]. *Zeitschrift für Experimentelle und Angewandte Psychologie*, 40, 577–610.
- Rabinowitz, M. B., Wang, J. D., & Soong, W. T. (1991). Dentin lead and child intelligence in Taiwan. *Archives of Environmental Health*, 46, 351–360.
- Raven, J. C. (1990). *Manual for Raven's Progressive Matrices and Vocabulary Scales. Research supplement no. 3* American national and school district normative and validity studies set in an international context together with a review of the use of the RPM in neuropsychological assessment (2nd edition). Oxford, UK: Oxford Psychologists Press.
- Raven, J. C., Court, J. H., & Raven, J. (1990). *Manual for Raven's Progressive Matrices and Vocabulary Scales. Section 2: Colored Progressive Matrices (1990 edition, with U. S. norms)*. Oxford, UK: Oxford Psychologists Press.
- Raven, J., Raven, J. C., & Court, J. H. (1992). *Manual for Raven's Progressive Matrices and Vocabulary Scales. Section 3: Standard Progressive Matrices: 1992 edition including American and international adult norms*. Oxford, UK: Oxford Psychologists Press.
- Reid, N., & Gilmore, A. (1989). The Raven's Standard Progressive Matrices in New Zealand. *Psychological Test Bulletin*, 2, 225–235.
- Rogers, W. A., Fisk, A. D., & Hertzog, C. (1994). Do ability-performance relationships differentiate age and practice effects in visual search? *Journal of Experimental Psychology: Learning, Memory and Cognition*, 20, 710–738.
- Rose, S. A., Feldman, J. F., & Wallace, I. F. (1992). Infant information processing in relation to six-year cognitive outcomes. *Child Development*, 63, 1126–1141.
- Rushton, J. P., & Skuy, M. (2000). Performance on Raven's matrices by African and White university students in South Africa. *Intelligence*, 28, 251–265.
- Rushton, J. P., Skuy, M., & Fridjhon, P. (2002). Jensen effects among African, Indian, and White engineering students in South Africa on Raven's Standard Progressive Matrices. *Intelligence*, 30, 409–423.
- Rushton, J. P., Skuy, M., & Fridjhon, P. (2003). Performance on Raven's Advanced Progressive Matrices by African, East Indian, and White engineering students in South Africa. *Intelligence*, 31, 123–137.
- Schweizer, K. (1991). On the replicability of the relation between reaction time components and intelligence. *Personality and Individual Differences*, 12, 857–864.
- Schweizer, K. (1993). The contribution of access to external information, stimulus complexity, and variability to cognitive abilities. *Personality and Individual Differences*, 14, 87–95.
- Sen, A., Jensen, A. R., Sen, A. K., & Arora, I. (1983). Correlation between reaction time and intelligence in psychometrically similar groups in America and India. *Applied Research in Mental Retardation*, 4, 139–152.
- Shigehisa, T., & Lynn, R. (1991). Reaction times and intelligence in Japanese children. *International Journal of Psychology*, 26, 195–202.
- Shyam, R. (1986). Variations in the concentration of 'g' level abilities among different groups. *Journal of Personality and Clinical Studies*, 2, 2123–2126.
- Shyam, R. (1987). Effect of enriched education programs on cognitive processing differentials of public school students. *Journal of Personality and Clinical Studies*, 3, 139–141.
- Shyam, R. (1994). Input registration and complex cognitive processing among tribals and non-tribals. *Asian Journal of Psychology and Education*, 27, 12–16.
- Sidles, C., & Mac Avoy, J. (1987). Navajo adolescents' scores on a primary language questionnaire, the Raven Standard Progressive Matrices (RSPM) and the Comprehensive Test of Basic Skills (CTBS): A correlational study. *Educational and Psychological Measurement*, 47, 703–709.
- Skuy, M., Gewer, A., Osrin, Y., Khunou, D., Fridjhon, P., & Rushton, J. P. (2002). Effects of mediated learning experience on Raven's matrices scores of African and non-African university students in South Africa. *Intelligence*, 30, 221–232.
- Slater, P. (1947). The association between age and score on the Progressive Matrices Test. *British Journal of Psychology*, 1, 64–69.
- Smagala, L. (1991). Les attitudes critiques des auditeurs vis-à-vis de l'enseignant [Critical attitudes of an audience towards its lecturer]. *European Review of Applied Psychology*, 41, 205–212.
- Soong, W.-T. (1997). [Intelligence research in Taiwan]. Unpublished raw data.
- Stacey, C. L., & Carleton, F. O. (1955). The relationship between Raven's Colored Progressive Matrices and two tests of general intelligence. *Journal of Clinical Psychology*, 11, 84–85.
- Stough, C., Nettelbeck, T., & Cooper, C. (1993). Raven's Advanced Progressive Matrices and increases in intelligence. *Personality and Individual Differences*, 15, 103–104.
- Sundet, K., Goffeng, L., & Hoff, E. (1995). To drive or not to drive: Neuropsychological assessment for driver's license among stroke patients. *Scandinavian Journal of Psychology*, 36, 47–58.
- Swirsky-Sacchetti, T., Gorton, G., Samuel, S., Sobel, R., Genetta-Wadley, A., & Burleigh, B. (1993). Neuropsychological function in borderline personality disorder. *Journal of Clinical Psychology*, 49, 385–396.
- Szustrowa, T., & Jaworowska, A. (1992). *Podrecznik do Testu Matryc Ravena. Wersja Kolorowa (1956). Polska standaryzacja 1991 (3;11-9;11)*. Raven's Progressive Matrices Manual. Colored Version (1956). Polish standardization 1991 (3;11-9;11). Warsaw, Poland: Polish Psychological Association.
- Taborda de Velasco, A. (1996). Algunas consideraciones sobre el diagnóstico integral en relación al rendimiento académico. [Some considerations concerning the measurement of academics' relational proficiency]. Unpublished manuscript.
- Taylor, L. J., & Skanes, G. R. (1977). A cross-cultural examination of some of Jensen's hypotheses. *Canadian Journal of Behavioral Science*, 9, 315–322.
- Tomic, W., & Klauer, K. J. (1996). On the effects of training inductive reasoning: How far does it transfer and how long do the effects persist? *European Journal of Psychology of Education*, 11, 283–299.
- Tulkin, S. R., & Newbrough, J. R. (1968). Social class, race, and sex differences on the Raven (1956) Standard Progressive Matrices. *Journal of Consulting and Clinical Psychology*, 32, 400–406.
- Underwood, J., & Underwood, G. (1987). Data organization and retrieval by children. *British Journal of Educational Psychology*, 57, 313–329.
- Valencia, R. R. (1979). Comparison of intellectual performance of Chicano and Anglo third-grade boys on the Raven's Colored Progressive Matrices. *Psychology in the Schools*, 16, 448–453.
- Van Bon, W. H. J. (1986). *Raven's Colored Progressive Matrices: Nederlandse normen en enige andere uitkomsten van onderzoek*. Raven's Colored Progressive Matrices: Dutch norms and some other research results. Lisse, Netherlands: Swets Test Services.
- Van de Ven, A. H. G. S., & Ellis, J. L. (2000). A Rasch analysis of Raven's Standard Progressive Matrices. *Personality and Individual Differences*, 29, 45–64.
- van den Broek, M. D., & Bradshaw, C. M. (1994). Detection of acquired deficits in general intelligence using the National Adult Reading Test and Raven's Standard Progressive Matrices. *British Journal of Clinical Psychology*, 33, 509–515.
- Vernon, P. E. (1947). The variations of intelligence with occupation, age, and locality. *British Journal of Psychology*, 1, 52–63.
- Vickers, D., Pietsch, A., & Hemingway, T. (1995). Intelligence and visual and auditory discrimination: Evidence that the relationship is not due to the rate at which sensory information is sampled. *Intelligence*, 21, 197–224.
- Warburton, F. W. (1951). Relationship between intelligence and size of family. *Eugenics Review*, 43, 36–37.
- Warburton, F. W. (1952). Relationship between the intelligence of students and size of family. *Eugenics Review*, 43, 188–192.
- Wober, M. (1969). The meaning and stability of Raven's Matrices test among Africans. *International Journal of Psychology*, 4, 229–235.
- Wright, S. C., Taylor, D. M., & Ruggiero, K. M. (1996). Examining the potential for academic achievement among Inuit children: Comparisons on the Raven Coloured Progressive Matrices. *Journal of Cross-Cultural Psychology*, 27, 733–753.
- Wysocki, B. A., & Cankardas, A. (1957). A new estimate of Polish intelligence. *Journal of Educational Psychology*, 48, 525–533.
- Yeudall, L. T., Fromm, D., Reddon, J. R., & Stefanyk, W. O. (1986). Normative data stratified by age and sex for 12 neuropsychological tests. *Journal of Clinical Psychology*, 42, 918–946.